

**MINUTES OF THE  
43<sup>RD</sup> MEETING OF WORKING GROUP OF NIH  
HELD AT NIH, ROORKEE, DURING DECEMBER 8-9, 2015**

The 43<sup>rd</sup> meeting of the Working Group of NIH was held at NIH, Roorkee, during December 8-9, 2015 under the Chairmanship of Director, NIH. The list of the participants of the meeting is given in Annexure-I.

**ITEM NO. 43.1: OPENING REMARKS BY THE CHAIRMAN**

Er R D Singh, Director, NIH & Chairman, WG welcomed the Working Group members and the Scientists of the Institute. The Chairman informed that the Ministry of WR, RD & GR, is directing the Institute to take up more and more action-oriented research for benefit of the stakeholders. Also, he mentioned that many new projects are expected to commence in the Institute, namely- National Hydrology Project, Neeranchal Watershed Project, NMSHE Project, "Water RAIN-Him" project under support from Swedish Meteorological and Hydrological Institute (SMHI), a project under Newton-Bhabha Program of MoES.

The Chairman then requested the Working Group members to give their general observations, suggestions and remarks on the scientific activities of the Institute. These are summarized below:

<b>S N</b>	<b>Member</b>	<b>Suggestion(s)</b>
1	Dr N B N Prasad	<ul style="list-style-type: none"> <li>▪ Reports of completed projects should be shared with CWC, CGWB, MoWR, etc.</li> <li>▪ Stakeholders benefits should be specified</li> <li>▪ Improve presentation of slides</li> <li>▪ Improve inter-divisional communications</li> <li>▪ Have pre-Working Group discussions</li> </ul>
2	Dr R D Deshpande	<ul style="list-style-type: none"> <li>▪ Do dependable research</li> <li>▪ Convert observations into inferences and implications</li> <li>▪ Form Research Coordination Groups for integration of projects/studies</li> <li>▪ Limit number of slides for presentation</li> <li>▪ Attendance of Scientists in Working Group meeting should be mandatory</li> </ul>
3	Dr. M Perumal	<ul style="list-style-type: none"> <li>▪ Bring good publications on snow and glacier hydrology</li> <li>▪ Focus on urban hydrology studies</li> </ul>
4	Dr Ritesh Arya	<ul style="list-style-type: none"> <li>▪ Improve communication skills</li> </ul>
5	Dr D V Reddy	<ul style="list-style-type: none"> <li>▪ Include abstract of studies in Division's work program table</li> <li>▪ Avoid duplication of studies</li> <li>▪ Establish a databank of available data at NIH</li> </ul>
8	Er R K Khanna	<ul style="list-style-type: none"> <li>▪ Identify end users for all projects/studies</li> <li>▪ Work on forecasting and management of natural disasters</li> <li>▪ Hold a training course on EIA</li> <li>▪ Hold a seminar on IWRM</li> <li>▪ Initiate a PG Diploma/Certificate course on IWRM</li> </ul>

After taking the views of the members and their self-introduction, the Chairman asked the Member-Secretary to take up the agenda of the meeting.

**ITEM No. 43.2: CONFIRMATION OF THE MINUTES OF 42<sup>nd</sup> MEETING OF THE WORKING GROUP**

The 42<sup>nd</sup> meeting of the Working group was held during March 19-20, 2015. The minutes of the meeting were circulated to all the members and invitees vide letter No. RCMU/WG/NIH-10 dated April 8, 2015. No Comments were received. The members confirmed the Working Group minutes.

**ITEM No. 43.3: ACTION TAKEN ON THE DECISIONS/RECOMMENDATIONS OF THE PREVIOUS WORKING GROUP MEETING**

Dr V C Goyal gave a brief account of the actions taken on the recommendations/decisions of the 42<sup>nd</sup> working group meeting.

**ITEM Nos. 43.4: PRESENTATION AND DISCUSSION ON THE STATUS AND PROGRESS OF THE WORK PROGRAMME FOR THE YEAR 2015-16**

The Member-Secretary requested the respective Divisional Heads to present the progress of studies carried out during 2015-16. Accordingly, the progress of various studies and sponsored projects was presented by all Scientific Divisions on their turn during the two day deliberations of the Working Group. The Division wise minutes of each study/project presented during the meeting are given below:

## ENVIRONMENTAL HYDROLOGY DIVISION

S.No.	Title of the Project/Study, Status, Study Team, Duration	Recommendations/Suggestions
<b>Internal Studies</b>		
1.	Water Quality Modelling using Soft Computing Techniques Status: In progress Study group: Rama Mehta (PI), C. K. Jain Duration: 2 Years (05/14-05/16)	No comments
2.	Himalayan River Water Quality Assessment in a Stretch from Gangotri to Haridwar. Status: In progress Study group: Rajesh Singh (PI) , C. K. Jain , M. K. Sharma, S. P. Rai , Renoj J. Thayyan, J. P. Patra Duration: 3 Years (07/14-06/17)	<ul style="list-style-type: none"> <li>• Dr. G. P. Juyal, CSWCRTI, Dehradun suggested correlation of contamination with domestic effluents.</li> </ul>
<b>Internal Studies (New)</b>		
3.	Status Report on Phytoremediation of Wastewater Study group: Rajesh Singh (PI) , C. K. Jain Duration: 6 Months (11/15 – 04/16)	No comments
<b>Sponsored Projects</b>		
4.	Ionic Enrichment Dynamics of Glacial Sediment and Melt water of Gangotri Glacier, Sponsored by DST, New Delhi Status: Ongoing Team: M. K. Sharma (PI), C. K. Jain, Renoj Thayyan, Manohar Arora, Naresh Kumar, Jatin Malhotra, Rakesh Goyal, Dayanand, Shyamlal Duration: 3 Years (04/14-03/17)	<ul style="list-style-type: none"> <li>• Dr. Ghosh suggested to consider travel time between different sties of the study area while interpreting the results. Dr. Bartarya recommended to incorporate ammonia in the list of parameters analysed. Dr. Guyal and Dr. Deshpande appreciated the study.</li> </ul>

## GROUND WATER HYDROLOGY DIVISION

Dr. N. C. Ghosh, Scientist 'G' & Head presented an overview and progress of studies and activities carried out by the division during the period April 2015 - November 2015. While presenting the technical activities carried out and progress made on different studies during last six months, he gave an account of scientific personnel available at the division and the sponsored and consultancy projects being pursued by the Division. He informed that three in-house R&D studies approved for the year 2015-16, which are being continued and three new studies have been proposed for the year 2015-16, out of these two are sponsored and one is in-house study.

He also informed that the division has organized a one-day workshop on “*Indo-German Workshop on “Bank Filtration in India” under Indo-German Competence Centre for Riverbank Filtration*” on 28<sup>th</sup> September, 2015 at NIH, Roorkee. In addition, the “Centre of Excellence for Advanced Groundwater Research” was officially inaugurated by the Hon’ble Union Minister for Water Resources, River Development and Ganga Rejuvenation, Sushri Uma Bharati on 26<sup>th</sup> October, 2015. As professional scientific outputs, scientists of the division have published a number of research papers in various journals/conferences and delivered lectures in various training courses during the period.

The study-wise progress reported and suggestions emerged are given below.

**Project Ref. Code: NIH/GWD/NIH/15-18: Development of Website and e-Portal on “Mitigation and Remedy of Arsenic Menace in India”**

P.I. of the project, Mr. C. P. Kumar (PI) was on leave and hence the progress of the study could not be made. Dr. N. C. Ghosh informed that the study would require funding from M/o WR, RD & GR. Since, no funding and official confirmation were received from the Ministry, the project activities has been deferred. Director, NIH, however, informed that the fund for the project would be made by MoWR, RD & GR in future.

**Project Ref. Code: NIH/GWD/NIH/14-17: Management of Water Resources for Quantity and Quality in Yamuna-Hindon Inter-basin**

Dr. Anupma Sharma (PI) presented the progress of the study. She informed that the groundwater levels in the area have been declined and the presence of harmful contaminants in some portions of the shallow groundwater system was evident. The depletion in water table in Baghpat district along with possible impacts on river flow was also highlighted. Suggestions were made about using CGWB water level data for the study area in addition to the State Department data for better representation.

**Project Ref. Code: NIH/GWD/NIH/15-16: Alternate Water Supply Management Strategies in Arsenic Affected/ Vulnerable Areas: Mapping of Arsenic Affected Zones/ Regions in Eastern U.P.**

Mr. Sumant Kumar (PI) presented the objectives, progress and future plans of the study. Mr. Sumant Kumar informed that team member Mrs. Shashi Poonam Indwar has been replaced by Mrs. Suman Gurjar and one new member (Mrs. Anju Chowdhary) has been included in team members. It was advised by Dr. Prasad and Dr. Bartarya that

health survey should be done for vulnerable risk zone mapping. Dr. V.C. Goyal suggested that IRMA, Anand can be contacted for doing vulnerable mapping. Dr. Reddy suspected that duration of study is short. Dr. N.C. Ghosh informed that as per the need of the study, it can be extended phase-wise.

**Project Ref. Code: NIH/GWD/NIH/15-18: Peya Jal Suraksha - Development of Six Pilot Riverbank Filtration Demonstrating Schemes in Different Hydrogeological Settings for Sustainable Drinking Water Supply**

Dr. N. C. Ghosh (PI) presented the objectives, mechanism of riverbank filtration (RBF), potential of RBF under different geological settings and future plans of the study. He informed that six pilot riverbank filtration demonstration schemes would be developed under this study at Laksar (Uttarakhand), Agra and Mathura (Uttar Pradesh), Sahebganj (Jharkhand), Bhojpur (Bihar) and Vizag (Andhra Pradesh) in consultation with the respective State departments. The funding for the study would exclusively be provided by the Ministry of Water Resources, River Development and Ganga Rejuvenation under the NIH's Plan Fund.

Dr. Surjeet Singh presented the progress made so far under the study mainly on the preliminary data collection on Yamuna river flows at Agra and Mathura from Central Water Commission and groundwater level and quality data from U.P. Groundwater Department, Lucknow. He also explained about the general soil type and geology of Agra and Mathura area, and presented the results of water quality and isotopic analysis.

**Project Ref. Code: NIH/GWD/NIH/15-16: Web Enabled "Groundwater Recharge Estimation Model (WE-GREM)"**

Ms. Suman Gurjar (PI) demonstrated the Web Enabled "Groundwater Recharge Estimation Model (WE-GREM)" and explained about objective, methodology and scope of the project. Dr. Reddy enquired about the data requirement for the model and also suggested to validate the model with other methods. In reply to his query, Dr N. C Ghosh (Co-PI) answered that it has validated with the observed field data. In reply to Working Group Members's query about the applicability of the model, Dr Ghosh said this model has been developed for estimating groundwater recharge from surface waterbody. It was informed that it would first made available online and on the basis of feedback from the users it would further be enhanced.

**Project Ref. Code: NIH/GWD/NIH/16-17: Groundwater fluctuations and conductivity monitoring in Punjab**

Dr. Gopal Krishan (PI) presented the objectives, methodology and future plans of the study. Dr. R.D. Deshpande (PRL, Ahmedabad) suggested to change/modify the objectives. Dr. D.V. Reddy (NGRI) suggested to plot conductivity, water level and rainfall together Dr. D.V. Reddy (NGRI) enquired about how data would be helpful for the whole study area. On this Dr. N.C. Ghosh replied that the baseline data has already been generated and these will help in conceptualizing the groundwater modeling aspect.

The work program of the division for the year 2015-16, as recommended by the Working Group, is given at Appendix-I.

**WORK PROGRAM OF GROUND WATER HYDROLOGY DIVISION  
FOR THE YEAR 2015-16**

S. No.	Project	Project Team	Duration & Status	Funding Source
1. NIH/GWD/NIH/ 15-18	Development of Website and e-Portal on "Mitigation and Remedy of Arsenic Menace in India"	C.P. Kumar (PI), Anupma Sharma, Suman Gurjar, Sanjay Mittal	3 years (04/15 – 3/18) <b>Status: In progress.</b>	Internal Funding.
2. NIH/GWD/NIH/ 14-17	Management of Water Resources for Quantity and Quality in Yamuna-Hindon Inter-basin	Anupma Sharma (PI) N. C. Ghosh Groundwater Hydrology Division in association with Prof. Deepak Kashyap, IIT Roorkee, as Technical Consultant	3 years (December, 2014 –Nov., 2017) <b>Status: In progress.</b>	Internal Funding.
3. NIH/GWD/NIH/ 15-16	Alternate water supply management strategies in arsenic affected/ vulnerable areas: Mapping of Arsenic affected zones/regions in Eastern U.P	Sumant Kumar (PI) N.C. Ghosh, Rajesh Singh, R.P. Singh, Suman Gurjar, S.L. Srivastava, Anju Choudhary	1 year (04/15 – 3/16) <b>Status: In progress.</b>	Internal Funding.
<b>Proposed New Study</b>				
4. NIH/GWD/NIH/ 15-18	<b>Peya Jal Suraksha</b> - Development of Six Pilot Riverbank Filtration Demonstrating Schemes in Different Hydrogeological Settings for Sustainable Drinking Water Supply.	N.C. Ghosh (Project Coord. & Leader) C.P. Kumar, B. Chakraborty, Y.R.S. Rao, Anupma Sharma, Surjeet Singh, Sumant Kumar, Suman Gurjar, S.P. Indwar, R.P. Singh, Anju Choudhary, Sanjay Mittal, Ram Chandar, Staff SW Lab	2.5 year (11/15 – 4/18) <b>Status: New.</b>	Sponsored by MoWR, RD & GR under Plan Fund.
5. NIH/GWD/NIH/ 15-16	Web Enabled "Groundwater Recharge Estimation Model (WE-GREM)".	Suman Gurjar (PI), N.C. Ghosh, Sumant Kumar, Surjeet Singh, Anupma Sharma	1 year (08/15 – 3/16) <b>Status: New.</b>	Internal Funding.
6. NIH/GWD/NIH/ 16-17	Groundwater fluctuations and conductivity monitoring in Punjab.	Gopal Krishan (PI), N.C. Ghosh, Surjeet Singh, Dan Lapworth (PI from UK) Alan MacDonald (Project Coordinator)	1 year (01/16 – 12/17) <b>Status: New.</b>	Sponsored by BGS, UK.

## HYDROLOGICAL INVESTIGATIONS DIVISION

Dr. Sudhir Kumar, Scientist G and Head, presented an overview and progress of studies and activities carried out by the Hydrological Investigations Division during the year 2015-16. He informed that out of 7 internal R&D studies approved for the year 2015-16, 2 studies have been completed. Out of the 5 sponsored studies, one study on sponsored by IAEA has been successfully completed, while 3 studies are being continued, and one has not been started as the sanction of the project is awaited from DST. He further informed that the scientists of the division have also completed 3 consultancy projects. During the last 8 months, 8 new consultancy projects have been started by the Division. The division has also completed one training programs and published more than 30 papers in Journals and conferences.

The study-wise progress reported and suggestions emerged are given below.

### **INTERNAL STUDIES:**

#### **1. PROJECT REFERENCE CODE: NIH/HID/INT/2013-15/2**

##### **Title of the Study: Isotope Studies for the Identification of Different Aquifer Groups and their Dynamics in Upper Yamuna River Plains**

Dr. Sudhir Kumar (PI) informed that progress of the work done upto March, 2015 was presented in the last meeting wherein it was informed that analysis of the noble gases for 12 samples has been completed from IAEA Vienna and that the results indicated a good correlation between the age of groundwater with built up of He in the groundwater.

He further informed that the remaining samples from Haryana side have been collected and have been sent to IAEA Vienna for analysis. As the analysis process is delayed, the results are expected by the end of December 2015.

Keeping in view the delay in analysis, the PI requested to extend the study till 31 March 2016.

Working group noted the progress of the work done under the study and extended the study till 31<sup>st</sup> March, 2016.

#### **2. PROJECT REFERENCE CODE: NIH/HID/INT/2013-15/4**

##### **Title of the Study: Estimation of Radon Concentration in Water and Identification of Paleo-groundwater in Part of Punjab Located in Satluj River Basin using Isotopes**

Sh. S. K. Verma, the principal investigator of the study, presented the study before the members of the WG meeting. He mentioned about the objectives of the study along with the location of study area, brief methodology, action plan, achievement so far received for the study etc. He also mentioned that there were no comments or suggestions raised during the last working group meeting i.e. 42<sup>nd</sup> meeting of working group held during 19-20 March, 2015.

While discussing the progress of the study, he informed that 1<sup>st</sup> objective of the study has been achieved. The groundwater samples collected from intermediate/deep tube wells from 7 districts located in the study area have been analysed for radon concentration. The radon concentrations monitored in these districts were found within the maximum permissible limit for drinking water as per the guide lines of WHO. Sh. Verma further informed that 2<sup>nd</sup> objective of the study has been achieved partially as the analysis of environmental tritium in 15 groundwater

samples which were collected during the latest field trip is in progress to identify the location of old groundwater.

The working group noted the progress of the study. No comments were received from the members.

**3. PROJECT REFERENCE CODE: NIH/HID/INT/2014-16/1**

**Title of the Study: Interaction between groundwater and seawater along the north east coast of India**

Dr M. S. Rao as a PI of the study informed that due to release of the budget in November, 2015, the project could only be initiated from the last week of November, 2015. A field work to east-coast of India from Bakkhali in West Bengal to Puri in Odisha state was conducted in the last week of November, 2015. Total 45 seawater and groundwater samples together were collected along 10 cross sections. Field parameters EC, Temp, pH and dissolved radon were measured at the time of sampling. Out of 10 cross sections only at two sites (at Noagarh and a site near Chandipur beach in Odisha) groundwater was observed saline otherwise, at all sites even at locations within 200 meters from sea the groundwater was found within salinity value of 1500 mS/cm. Along all the cross sections, radon was observed to decrease towards the coast. The deep sea water collected from Puri coast was having salinity 39mS/cm. The collected samples were brought to laboratory at NIH for further analysis. He also informed that the next field work to southern stretch of Puri will be conducted during Jan-Mar 2016. The working group noted the progress of the study. No comments were received.

**4. PROJECT REFERENCE CODE: NIH/HID/INT/2014-16/2**

**Title of the Study: Isotopic investigation of benchmark Himalayan glaciers**

Dr M. S. Rao, PI of the project informed that due to delay in release of funds, the work was mainly relied on the glacial core and snow melt samples extended to NIH by Prof. AL Ramanathan, JNU, New Delhi who is also a member of the study group. The collected samples were from Chhota Shigri glacier. Due to unavailability of long corer, only 4m glacial core could be raised for the analysis. The samples received at NIH are getting processed for isotopic analysis. Dr Rao informed that for systematic study to achieve objectives of the project a corer to raise glacial core of size 10 m, insulation box to transport the core to laboratory without the core getting melted and glacial preservation unit may be required Based on analysis of Chhota Shigri glacial samples, the 1st interim report will be submitted. The working group noted the progress of the study. No comments were received.

**5. PROJECT REFERENCE CODE: NIH/HID/INT/2014-16**

**Title of the Study: Assessment of dissolved radon concentration for groundwater investigations in Haridwar district**

Dr. Sudhir Kumar briefed about the study and informed that the study was undertaken with the objectives to assess the presence of radon in groundwater in Haridwar district. He informed that the study has been completed and final report shall be submitted soon.

**6. PROJECT REFERENCE CODE: NIH/HID/INT/2015-16/1**

**Title of the Project: Status Report on Rewalsar Lake, Himachal Pradesh**

Dr. Khobragade, PI, presented the progress made under the study. He informed that the water quality sampling of the lake was carried out during the month of July 2015 and presented the analysis. It informed that, in general, the lake water quality of Rewalsar Lake is good, indicating absence of organic pollution. This according to him could be due the dilution effect caused by



the water received from the rain as direct fall over the lake, as the sampling was done during monsoon. However, keeping in view the death of fish reported for the lake during summer, he informed that sampling shall be carried out during winter and summer months also, to analyse the seasonal variation and also informed that heavy metals shall also be considered for analysis in future sampling. He also presented the analysis of the isotopic investigations and caesium dating of sediment. It was informed that the rate of sedimentation for the Rewalsar lake as per caesium-137 dating techniques comes out to be 0.82 cm/year.

The working group noted the progress of the study. No comments were received.

**7. PROJECT REFERENCE CODE: NIH/HID/INT/2015-18/1**

**Title of the Project: Lake-Groundwater Interaction Studies for Sukhna Lake, Chandigarh**

The progress of the study was presented by Dr. S. D. Khobragade, PI of the study. He presented the variation in daily water levels of the lake for the post monsoon period of 2011-2014 and informed that the variation is due to variation in seepage losses, which in turn depends upon the water level reached by the lake at the end of the monsoon season. He informed that, based on water balance, the seepage losses from the lake are 10-40% of the total losses from the lake. He also presented water quality data such as temperature, pH, EC etc of the lake water and the two piezometers upstream and downstream of the lake, which also indicate seepage losses from the lake. He further informed that daily water level of the lake and the two piezometers is being monitored for further detailed analysis. The data collected during the period of July, 2015 to October, 2015 was presented and it was observed that long term data shall be needed for further detailed analysis of seepage problem. Seepage rates obtained from analysis of water balance of post monsoon months for the period of 2011-2014 were also presented and discussed.

The working group noted the progress of the study. No specific comments were received.

**SPONSORED PROJECTS:**

**8. PROJECT REFERENCE CODE: NIH/HID/MOES/2012-15**

**Title of the Study: The Structure and Dynamics of Groundwater Systems in North-western India under Past, Present and Future Climates**

Dr. S. P. Rai presented the study. Based on results of stable ( $\delta^2\text{H}$  and  $\delta^{18}\text{O}$ ) and radio-isotope ( $\delta^3\text{H}$ ) and hydrogeological data, Dr. S. P. Rai presented the progress study. The main highlights of the presentation were the identification of recharge source of the shallow and deeper groundwater aquifer. On a query from Dr. R. D. Deshpande, Dr. S. P. Rai informed about status of groundwater dating using  $^{14}\text{C}$ . Mr. Arya asked about the possibilities of recharge from the snow and glacier, Dr. Rai informed that isotopic signature reveals that source of recharges to groundwater through local rain and canal networks upto sampling depth.

**9. PROJECT REFERENCE CODE: NIH/HID/IAEA-1/2012-15**

**Title of the Study: The Use of Environmental Isotopes to Assess Sustainability of Intensively Exploited Aquifer Systems in North Eastern Parts of Punjab, India**

The study was presented by Dr. M. S. Rao, Sc-D and PI of the project. He informed that the study has been completed and the results were presented in the final review meeting held at IAEA, Vienna, Austria and also that the final report of the study in the format provided by the funding agency will be submitted before the end of December, 2015. He told that as per the objectives of the project, extent of and distribution of groundwater exploitation in the Bist Doab

region has been examined. Response delay between monsoon and recharge pick-up in deep aquifer is investigated, causes (transpiration, climate, direct withdrawal etc) resulting into groundwater depletion have been examined, isotopic characteristic of rainwater (LMWL), reservoir water, river waters and groundwater were developed to understand interconnectivity between shallow and deep aquifers and to map the surface & groundwater interaction zones and river interaction with groundwater in shallow & deep aquifer is examined for the purpose of augmentation of the falling groundwater levels. All the objectives of the project have been accomplished and the project is successfully completed. The working group noted the progress of the project. No comments were received.

**10. PROJECT REFERENCE CODE: NIH/HID/IAEA-2/2012-15**

**Title of the Study: Assessment of Baseflow and its Impact on Water Quality in the Part of Satluj River in India using Environmental Isotopes and Age Dating Techniques**

Dr. S. P. Rai presented the progress of the study. The results of the isotopes were presented in detail along with details of hydrogeological conditions. Dr. Rai also presented findings of surface water groundwater interaction, spatial variation of baseflow contribution to river in the study area. He further explained about the recharge source and zones of the groundwater in the study area.

The working group noted the progress of the study and appreciated the progress of the study.

**11. PROJECT REFERENCE CODE: NIH/HID/IAEA-3/2013-15**

**Title of the Study : Integration of Isotope Hydrology in Aquifer Mapping Efforts in India: A Pilot Study of Upper Yamuna Plains**

Dr. Sudhir Kumar (PI) informed that progress of the work done. He further informed that the remaining samples from Haryana side have been collected and sent to IAEA Vienna for analysis. As the analysis process is delayed, the results are expected by the end of December 2015. The IAEA has extended the project by a period of 9 months, i.e. upto 9<sup>th</sup> March, 2016.

Working group noted the progress of the work done under the study and extended the study till 9<sup>th</sup> March, 2016.

**12. PROJECT REFERENCE CODE:**

**Title of the Study: Understanding of hydrological processes in Upper Ganga basin by using isotopic techniques**

Dr. Sudhir Kumar informed that this study is being proposed under the NMSHE project which is under the process of finalization by the Institute as a sponsored project by DST. The study would be started once the project is approved.

**WORK PROGRAMME OF THE  
HYDROLOGICAL INVESTIGATIONS DIVISION FOR THE YEAR 2015-2016**

S. No.	Study	Team	Duration/ Status
<b>INTERNAL STUDIES</b>			
1.	Isotopic Studies for the Identification of Different Aquifer Groups and their Dynamics in Upper Yamuna River Plains	Sudhir Kumar (PI); C K Jain; SP Rai; SD Khobragade; P. K. Garg; CGWB, Lucknow & Chandigarh)	2 years (07/13-06/15) Continuing Study
2.	Estimation of Radon Concentration in Waters and Identification of Paleo-groundwater in Part of Punjab Located in Satluj River Basin using Isotopes	S. K. Verma (PI) S. P. Rai (Co-PI) M. S. Rao C. P. Kumar Mohar Singh	2 years (10/13-09/15)  Completed
3.	Interaction between groundwater and seawater along the northern part of east coast of India	M. S. Rao (PI), Sudhir Kumar Pankaj Garg	2 years (01/15 - 12/16) Continuing Study
4.	Isotopic investigation of benchmark Himalayan glaciers.	M. S. Rao (PI) S.P. Rai, Sudhir Kumar Pankaj Garg	2 years (01/15 - 12/16) Continuing Study
5.	Assessment of dissolved radon concentration for groundwater investigations in Haridwar district	Pankaj Garg (PI) Sudhir Kumar, M. Someshwar Rao	1 year (01/15 – 12/15) Completed
6.	Status Report on Rewalsar Lake, Himachal Pradesh	SD Khobragade (PI) Sudhir Kumar, C. K. Jain	1 year (04/15 – 03/16) New Study
7.	Lake-Groundwater Interaction Studies for Sukhna Lake, Chandigarh	SD Khobragade (PI); Sudhir Kumar; Senthil Kumar; Pankaj Garg	3 year (04/15 – 03/18) Continuing
<b>SPONSORED PROJECTS</b>			
8.	The Structure and Dynamics of Groundwater Systems in Northwestern India under Past, Present and Future Climates	S. P. Rai (PI); M. S. Rao; Surjeet Singh; S. K. Verma; C. P. Kumar; Sudhir Kumar	3 years (06/12-03/16) Continuing Study
9.	The Use of Environmental Isotopes to Assess Sustainability of Intensively Exploited Aquifer Systems in North Eastern Parts of Punjab, India	M. S. Rao (PI) C. P. Kumar S. P. Rai	3 years (09/12-12/15) Continuing Study
10.	Assessment of Baseflow and its Impact on Water Quality in the Part of Satluj River in India using Environmental Isotopes and Age Dating Techniques	S. P. Rai (PI) R. V. Kale M. S. Rao C. P. Kumar Sudhir Kumar	3 years (10/12-04/16) Continuing Study
11.	Integration of Isotope Hydrology in Aquifer Mapping Efforts in India: A Pilot Study of Upper Yamuna Plains	Sudhir Kumar (PI); S. P. Rai; S. D. Khobragade; C. K. Jain; P. K. Garg	2 years (05/13-03/16) Continuing Study

<b>S. No.</b>	<b>Study</b>	<b>Team</b>	<b>Duration/ Status</b>
12	Understanding of hydrological processes in Upper Ganga basin by using isotopic techniques	S. P. Rai (PI); Sudhir Kumar; Rajesh Singh; S. D. Khobragade; M. Arora; Dr. R. J. Thayyen; Sh. P. K. Garg	<i>To be under taken under NMSHE project</i>

#### **CONSULTANCY PROJECTS**

<b>S. No.</b>	<b>Study</b>	<b>PI</b>	<b>Duration/ Status</b>
1.	Hydrogeological Study for Dewatering of Jhamarkotra Mines, Distt. Udaipur	Sudhir Kumar	05/13-04/16 Continuing Study
2.	Estimation of canal seepage and groundwater recharge using isotopic techniques in the Chajlet block, Moradabad district, Uttar Pradesh	Sudhir Kumar	03/15-02/16 Continuing Study
3.	Hydrogeological and isotopic investigations of District Lalitpur and Jhansi of Bundelkhand region	S. P. Rai	05/15-01/16 New Study
4.	Hydro-geological study for Gadawara super thermal power project, Madhya Pradesh	SD Khobragade	07/15-06/16 New Study
5.	Hydro-geological study for Katwa super thermal power project, West Bengal	Sudhir Kumar	07/15 – 4/16 New Study
6.	Hydro-geological study for Darlipali super thermal power project, Odisha	Sudhir Kumar	9/15 – 8/16 New Study
7.	Hydro-geological study for Khargone super thermal power project, Madhya Pradesh	SD Khobragade	07/15 – 4/16 New Study
8.	Hydro-geological and isotopic study for 1x660 MW Harduaganj thermal power project, UP	Sudhir Kumar	11/15 – 10/16 New Study
9	Hydro-geological and isotopic study for 1x660 MW Panki thermal power project, UP	Sudhir Kumar	12/15 – 11/16 New Study
10	Hydro-geological study for Kudgi super thermal power project, Karnataka	Sudhir Kumar	11/15 – 10/16 New Study

## SURFACE WATER HYDROLOGY DIVISION

Dr. Rakesh Kumar, Head, Surface Water Hydrology Division gave a brief overview of the various scientific and other technical activities carried out by the Division after the previous meeting of the Working Group. Thereafter, the Scientists of the Surface Water Hydrology Division presented the progress achieved in carrying out the various studies as mentioned below.

### Work Programme of Surface Water Hydrology Division for the Year 2015-16

<b>S.No. &amp; Ref. Code</b>	<b>Title</b>	<b><u>Study Group</u></b>	<b>Duration</b>
1. NIH/SWD/NIH/ 12-15	Sedimentation Studies for Pong Reservoir, Himachal Pradesh	A. R. Senthil kumar Manohar Arora Suhas D Khobragade Avinash Agarwal Sanjay Jain	3½ years (April 2012 to September 2015)
2. NIH/SWD/NIH/ 13-15	Application of DSS (P) for Integrated Water Resources Development & Management	A.K. Lohani Surjeet Singh Rahul Jaiswal D.K. Sonkusale Akilesh Verma	2¼ years (April 2013 to June 2015)
3. NIH/SWD/NIH/ 13-16	Quantitative assessment of uncertainties in river discharge estimation	Sanjay Kumar Sharad Jain	3 years (April 2013 to March 2016)
4. NIH/SWD/NIH/ 13-16	Evaluation and modeling of hydrological support system for watersheds of Garhwal, Uttarakhand hills.	Avinash Agarwal Manohar Arora R.K. Nema	3 years (November 2013 to October 2016)
5. NIH/SWD/NIH/ 14-15	Estimation of Water Balance for Integrated Water Resources Management in Yerrakalva Pilot Basin, A.P.	J.V.Tyagi Y.R.S. Rao,	2 years (April 2014 to March 2016 )
6. NIH/SWD/NIH/ 14-17	Hydrological modeling of Brahmani Baitarani River basin using eWater Source platform	J.P. Patra Rakesh Kumar Pankaj Mani	3 years (April 2014 to March 2017)
7. NIH/SWD/NIH/ 14-17	Study of Rainfall Patterns and Comparison of Rainfall Data from different Sources for Uttarakhand State	Archana Sarkar Vaibhav Garg, Sc C, IIRS, Dehradun Rakesh Kumar N.K. Bhatnagar	3 years (April 2014 to March 2017)
8. NIH/SWD/NIH/ 14-17	Monitoring and modelling of streamflow for the Gangotri Glacier	Manohar Arora Rakesh Kumar	3 years (May 2014 to March 2017)
9. NIH/SWD/NIH/	Effect of climate change on evaporation at point scale	Digambar Singh A. R. Senthil	3 years (June 2014 to

14-17		kumar Manohar Arora	March 2017)
10. NIH/SWD/NIH/ 15-18	Generalization and parameter estimation of GEV distribution for flood analysis specific application in Indian data	S.K. Singh	1 year (April 2015 to March 2016)
11. NIH/SWD/NIH/ 15-16	Analytical Solution for Meeting of two surges or bores	S.K. Singh	1 Year (April 2015 to April 2016)
12. NIH/SWD/NIH/ 15-18	Flood and Sediment studies in Himalayan basin using MIKE-11 Model	A.K. Lohani S.K. Jain	3 years (April 2015 to March 2018)
13. NIH/SWD/NIH/ 15-18	Snowmelt Runoff Modelling and Study of the Impact of Climate Change in Sharda River Basin	Achana Sarkar T. Thomas Vaibhav Garg	3 years (April 2015 to March 2018)
14. NIH/SWD/NIH/ 15-18	Study on effect of climate change on sediment yield to Pong reservoir	A. R. Senthil Kumar J. V. Tyagi Avinash Agarwal Suhas Khobragade Manohar Arora	3 years (April 2015 to March 2018)
15. NIH/SWD/NIH/ 12-15	Study of regional drought characteristics and long term changes in supplemental irrigation water requirement in Seonath Basin in Chattisgarh	R.P. Pandey Rakesh Kumar	3 years (April 2012 to March 2015)
<b>New Study</b>			
16. NIH/SWD/NIH/ 15-17	Effect of Changing Global Tropospheric Temperature on Asia-Pacific Monsoon Circulation and rainfall fields across the India	Ashwini Ranade	2 years (October 2015 to March 2017)

S.N.	Title of Project/Study, Study Group, Start/Completion Dates	Status and Recommendations/Suggestions
1.	<p>Sedimentation Studies for Pong Reservoir, Himachal Pradesh</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>A. R. Senthil kumar Manohar Arora Suhas D Khobragade Avinash Agarwal and Sanjay Jain</p> <p>DOS: April 2012 DOC: September 2015</p>	<p>Dr. A. R. Senthil Kumar, PI of the project, presented the objectives, methodology and results of the study. The PI presented the development of sediment yield model for pong dam using ANN and the simulation of sediment yield for future 25, 50, 75 and 100 years using the generated series of rainfall and flow volume. The PI presented the results of the computation of unit weight of sediment, consolidated unit weight of sediment, trap efficiency of the reservoir, consolidated sediment volume and loss of reservoir capacity for future 25, 50, 75 and 100 years by different methods such as particle size distribution of suspended sediment concentration, porosity of the settled sediment, hydrographic survey and frequency analysis. The PI presented the computation of elevation-area-capacity table for the consolidated sediment volumes computed by different methods. The PI presented the results of sediment yield computed from dependable series of rainfall and flow volume and ANN ensembles.</p> <p>Dr. R. D. Deshpande, Scientist F, PRL, Ahmadabad inquired about the possibility of verification of the predicted elevation-area-capacity table. The PI replied that the whole computation was based on the historical data of rainfall, flow volume and sediment yield and the assumption of the present sediment generation process would continue for the prediction period. the elevation-area-capacity computation based on the historical was verified by the hydrographic survey conducted by BBMB. Shri Ritesh Arya, Dehradun suggested to consider the man made effect in the simulation of sediment yield. The PI Replied that the observed data of sediment yield used for the development of the model considers the man effect of sediment generation.</p>
2.	<p>Application of DSS (P) for Integrated Water Resources Development &amp; Management</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>A.K. Lohani Surjeet Singh Rahul Jaiswal D.K. Sonkusale Akilesh Verma DOS: April 2013 DOC: June 2015</p>	<p>Dr. Surjeet Singh mentioned that the DSS(P) software which was developed under HP-II is being applied for Arpa basin of Seonath river basin to demonstrate the capabilities of the DSS(P) model. Dr. Surjeet Singh mentioned that the various data have been collected from Chhattisgarh for the application of DSS(P) software. Dr Surjeet Singh further mentioned that the collected data have been computerized and a NAM rainfall-runoff model has been setup in Mike basin and Mike-11 RR. He further mentioned that the cropping pattern data is still awaited from the Water Resources Department, Chhattisgarh. After getting these data the DSS model will be applied for the selected basin.</p>

3.	<p>Quantitative assessment of uncertainties in river discharge estimation</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>Sanjay Kumar Sharad Jain</p> <p>DOS: April 2013 DOC: March 2016</p>	<p>Dr. Sanjay Kumar presented the study on “Quantitative assessment of uncertainties in river discharge estimation”. He explained the background and objectives of the study and informed that study is a part of the systemic review of uncertainty clause of the ISO 9123 document. He explained the methodology based on ISO documents GUM (Guide to the expression of uncertainty in measurement), HUG (Hydrometric uncertainty guidance) and presented the progress of the study. He informed that the review comments received on the working draft of ISO 9123 were discussed in the ISO meeting held during May 2015 in Tokyo. He mentioned that, based on the discussions in the Tokyo meeting, all the comments and suggestions from member countries were incorporated in the working draft. The updated draft (DIS) has been submitted to BIS/ISO for uploading on ISO website for further comments from member countries. After the presentation, Chairman suggested that the draft ISO document may be presented in the WG meeting after its finalization. There were no comments from other members.</p>
4.	<p>Evaluation and modeling of hydrological support system for watersheds of Garhwal, Uttarakhand hills</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>Avinash Agarwal, Manohar Arora R.K. Nema</p> <p>DOS: November 2013 DOC: October 2016</p>	<p>Dr. Manohar Arora presented the progress of the study. He informed the experts that the PI of the study is superannuating in the month of May 2016. The major objectives of the study have been achieved and the remaining period will be used for the final submission of the report and papers. The results included for two watersheds in the Himalayas and the recommendations of the study will be forwarded to the stakeholders.</p>
5.	<p>Estimation of Water Balance for Integrated Water Resources Management in Yerrakalva Pilot Basin, A.P.</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>J.V.Tyagi Y.R.S. Rao</p> <p>DOS: April 2014 DOC: March 2016</p>	<p>Shri J.P. Patra presented the progress made in carrying out the study. He explained that the objectives of the study are: (i) to calibrate and validate SWAT model for Yerrakalva pilot basin, and (ii) to compute water balance components of the hydrologic cycle for the basin. Shri Patra mentioned that SWAT is one of the most recent models developed by the USDA and it is being used to analyze and quantify the water balance of the Yerrakalva river basin. It is an integrated river basin scale, physically based, continuous-time, long-term simulation, distributed watershed model. Also, its suitability to different parts of the world has been well established. The SWAT model uses physically based inputs such as weather variables, soil properties, topography, land use characteristics and land-management practices occurring in the catchment. The hydrologic cycle as simulated by SWAT is based on the water balance equation. Model outputs all water balance components (surface runoff, evaporation, lateral</p>



		<p>flow, recharge, percolation, sediment yield, etc.) at the level of each watershed and are available at daily, monthly or annual time steps.</p> <p>It was presented that the daily rainfall data of the study area have been collected. Soil samples have been collected from the field and analyzed in the lab for determination of soil texture. Spatial maps viz. DEM, soil map and land use map have been prepared for the study area. Preparation of attribute data for the SWAT model is completed. Model set up for the study basin is completed. Extension for six months i.e. up to March 2016 is required was requested for completing the study.</p>
6.	<p>Hydrological modeling of Brahmani Baitarani River basin using eWater Source platform</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>J.P. Patra Rakesh Kumar Pankaj Mani</p> <p>DOS: April 2014 DOC: March 2017</p>	<p>Mr. Jagadish Prasad Patra, PI of the study presented the objectives, brief methodology with progress made during last six months. Various statistical analysis and trend analysis of stream flow data were presented. The catchment model setups in eWater source for the Baitrani basin was presented with preliminary calibration results and inter comparison of various objective functions and optimization methods. The members enquired about the different rainfall inputs to be used in the rainfall–runoff simulation. It was informed that presently the model is being calibrated with .25° grid daily rainfall data of IMD. It was also informed that the station rainfall will also be use in the model, but it is has may data gaps. There were no specific comments from the members.</p>
7.	<p>Study of Rainfall Patterns and Comparison of Rainfall Data from different Sources for Uttarakhand State</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>Archana Sarkar Vaibhav Garg, Sc C, IIRS, Dehradun Rakesh Kumar N.K. Bhatnagar</p> <p>DOS: April 2014 DOC: March 2017</p>	<p>Mrs. Archana Sarkar, PI of the study presented the background, objectives, methodology and expected deliverables of the new study. Mrs Sarkar informed that the study area is the Uttarakhand State, often referred to as the "Land of the Gods" due to the many holy Hindu temples and pilgrimage centres found throughout the state which observed a massive flood disaster in June 2013. Mrs. Sarkar informed the house that a good knowledge of local rainfall-regime is crucial for planning and management of domestic, urban as well as industrial water use, irrigation and crop practices besides forecasting and management of extreme events like floods and droughts. She further informed that in view of the recent flood disaster in the Uttarakhand state, it becomes all the more important to carry out a scientific analysis of the rainfall regime of the region. Mrs. Sarkar also informed that a comparative accuracy assessment of various data sources of rainfall viz, Rain gauges, satellite sensors (TRMM), and high resolution gridded re-analysis rainfall (APHRODITE) is of prime importance as the rainfall data from these data sources are further provided to hydrological models to produce forecasts. Mrs. Sarkar presented the progress of the study with results of trend analysis of historical rainfall data (annual, seasonal and monthly) as well as number of rainfall events of various intensity (annual and monsoon) by parametric and non-</p>

		parametric methods for ten rainfall stations (grid centres) five each in Kumaon and Garhwal regions using IMD gridded rainfall data of 113 years (1901 to 2013). Mrs Sarkar informed about the further work that will be carried out for rainfall comparison for different sources of rainfall. Working group members noted the progress of the study as well as appreciated the work.
8.	<p>Monitoring and modelling of Gangotri Glacier melt runoff and simulation of streamflow under different climatic scenarios</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>Manohar Arora Rakesh Kumar</p> <p>DOS: May 2014 DOC: March 2017</p>	<p>Dr Manohar Arora presented the progress of the study. He informed the house that the data collected for the ablation period of 2015 has been analyzed and the results were presented. He informed the house that the total volume of water from the glacier for the entire melt season was 882 MCM with the date of peak discharge on 7<sup>th</sup> August 2015. The GCM future scenarios were also presented before the experts. Dr Ritesh Arya wanted to know whether the paleo records of recession were being analysed. In its response it was informed that this project is a part of Integrated Study of Gangotri Glacier and NIH has the responsibility of hydrological study only. The paleo records are being analysed by JNU and the results are submitted to DST.</p>
9.	<p>Effect of climate change on evaporation at point scale</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>Digambar Singh A. R. Senthil kumar Manohar Arora</p> <p>DOS: June 2014 DOC: March 2017</p>	<p>Shri Digambar Singh, PI of the study, presented the objectives, methodology and progress of the study from April 2015 to November 2015. The PI explained the computation of evaporation by different methods such as Meyer, Penman and empirical equation and evapotranspiration using Hargreaves method. The PI presented the deviation of evaporation from the mean by different methods for winter, pre monsoon, and monsoon and post monsoon periods. The trend of evaporation computed by different methods was also presented. Dr. N B N Prasad, Executive Director, CWRDM, Kunnamangalm suggested to see the correlation of evaporation with wind velocity and radiation data and conclusion of trend of evaporation could be drawn based on that. Dr. S K Baratarya suggested to check the computed evaporation with the observed data nearby monitored by IMD or other organizations. Dr. R. D. Deshpande inquired about the reason for the decreasing trend of evaporation. The PI Replied that it is because of new built up buildings nearby the observatory.</p>
10.	<p>Generalization and parameter estimation of GEV distribution for flood analysis specific application in Indian data</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>S.K. Singh</p> <p>DOS: April 2015 DOS: March 2016</p>	<p>Dr. S. K. Singh presented the study highlighting the intended objectives of the study. The GEV distribution as is widely used has two different forms (Type 2 and Type 3) as used in flood frequency analysis. The mathematical unification of Type-2 and Type-3 GEV distribution, which are respectively used for analyses of high flow and low flow, is complete. Its testing on few widely used data sets along with the development of both a simple and optimization method for the estimation of its parameters is in progress. Dr. Perumal inquired about the advantages of the unification in terms of using this unified one vis-à-vis using</p>

		<p>GEV-2 and GEV-3 in isolation for the analyzing high flows, and low flows, respectively. Dr. Singh informed that the unification gives the physical uniqueness and a better interpretation of the parameters in case of the respective analyses of high flows and low flows, as these pertains to the same unified distribution. In principle, when we united two equations by a single equation, the work quanta, however the specific advantages would be brought out after the testing part.</p> <p>The chairman suggested to present the results of testing in the next Working- group and opined that this study would be a very good one if the unification is justified and workable.</p> <p>Dr S. K. Singh proposed to have a separate new study of one year duration covering the multiple- application of developments in this study to extensive Indian data-set available/collected at NIH and CWC, with commencing the study in Dec 2015 and collecting the data till March 2016 then completing the application-part and the report by March 2017.</p>
11.	<p>Analytical Solution for Meeting of two surges or bores</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>S.K. Singh</p> <p>DOS: April 2015 DOC: April 2016</p>	<p>Dr. S. K. Singh presented the study highlighting the intended objectives of the study as developing analytical equations/solutions in case two surges or bores in rectangular channel intersection from opposite direction, avoiding the currently used iterative solution, with a systematic treatment of surges. An abrupt change in discharge or depth of flow causes a surge or bore in channels. This abrupt change may be due to a sudden opening or closure of gate, part-blockage of a channel due to landslide or tidal effect. The mathematical development for the analytical approach is complete and the testing of the solution on the published data-sets is in progress. There was no suggestion from the members at this stage.</p>
12.	<p>Flood and Sediment studies in Himalayan basin using MIKE-11 Model</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>A.K. Lohani Sanjay K. Jain</p> <p>DOS: April 2015 DOC: March 2018</p>	<p>Dr. Rakesh Kumar explained that the objectives of the study are: (i) to model the floods generated due to cloud burst events, (ii) to develop discharge-sediment relationship, and (iii) to assess sediment dynamics in the river system. The methodology of the study includes: (i) analysis of available precipitation data for different return period for the identified sub basin, (ii) historical study of cloud bursts in the Himalayan Region, (iii) study of phenomenon of cloud bursts, (iv) quantification of cloud burst phenomenon into flood hydrograph at the critical section in the river stream, (v) flood routing of cloud burst flood and (v) development of MIKE-11 based sediment model to assess the sediment dynamics of the river system.</p> <p>It was also mentioned collection of data/ information related to cloud burst and sediment is in progress. Central and State organizations working in the area have been contacted for the required data/ information. Model for flood modeling is being setup for the hypothetical cases</p>

		and the study is under progress.
13.	<p>Snowmelt Runoff Modelling and Study of the Impact of Climate Change in Sharda River Basin</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>Achana Sarkar T. Thomas Vaibhav Garg</p> <p>DOS: April 2015 DOC: March 2018</p>	<p>Mrs Archana Sarkar, PI of the study presented the background, objectives, methodology and expected outcomes of the study. Mrs Sarkar informed the house that the National Action Plan for Climate Change has launched 8 missions including National Water Mission. The Prime Minister's Council on Climate Change, in its first meeting decided that MoWR should initiate studies for major rivers whose waters come from snow melt. Accordingly, MoWR chalked out an Action Plan to take up related studies on Indus, Ganges and Brahmaputra River basins through CWC, NIH and Brahmaputra Board. Mrs Sarkar informed that the Institute has already carried out related studies for the Ganges basins mostly in the Garhwal Himalayas but the proposed study would be the first one for the Kumaon Himalayan River basin. Mrs Sarkar told that rainfall data collected for the Sharda River basin in a previous study would be utilized in addition to other procured data during study. Degree day approach along with soft computing would be followed for hydrological modeling including snowmelt runoff modelling. Various scenarios of precipitation and temperature would be considered to study the impact of climate change on the hydrological regime of the study basin using GCM outputs. Mrs. Sarkar presented the progress of the study with results showing various basin maps (drainage, DEM etc). She also informed about the snow cover maps being prepared using the MODIS data. Mrs. Sarkar informed that technical reports would be prepared after every year of the study. Working group members noted the progress of the study.</p>
14.	<p>Study on effect of climate change on sediment yield to Pong reservoir</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>A. R. Senthil Kumar J. V. Tyagi Avinash Agarwal Suhas Khobragade Manohar Arora</p> <p>DOS: April 2015 DOC: March 2018</p>	<p>Dr. A. R. Senthil kumar, PI of the project, presented the objectives, methodology and the progress made during April 2015 to November 2015. The sediment inflow to Pandoh reservoir located in the upstream of the reservoir is not observed and it is an important input to the SWAT model. The trap efficiencies of Pong and Bhakra reservoir are 97.11 % and 99.34 % respectively. PI presented the possibility of using the average of trap efficiencies of the reservoirs and the sediment yield observed at Manali, downstream of Pandoh reservoir, to compute the inflow of sediment into the reservoir. The PI also informed to the house that he would like to change the study area from Pong to Tehri if the computation of sediment yield into Pandoh reservoir is not representative of the reservoir.</p>
15.	<p>Study of regional drought characteristics and long term changes in supplemental irrigation water requirement in Seonath Basin in Chattisgarh</p>	<p>The Head Surface Water Hydrology Division reported an over view about the progress of studies and subsequently invited Dr R.P. Pandey, PI of the project to make presentation and explain the details of the work done and the progress of study. Dr Pandey presented the complete progress of data collection, analysis and results of various sections of analysis and the work done under this study.</p>

	<p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>R.P. Pandey Rakesh Kumar</p> <p>DOS: April 2012 DOC: March 2015</p>	<p>He informed that the various parts of Seonath basin faced crop failure and acute water shortages from time to time specially due to drought and failure of monsoon rains. He informed that the Seonath river basin is the longest tributary of the Mahanadi basin draining three districts of Chhattisgarh namely Durg, Rajandgaon and Bilaspur. The drainage area of the Seonath river basin is 30,860 Sq km. which comprises nearly 25% of the upper catchment of the Mahanadi basin.</p> <p>In the presentation the progress of preparation of base Maps, preliminary analysis of the long-term-rainfall variability, trends of annual and seasonal rainfall, temperature, humidity and wind speed were shown to the working group. Dr Pandey informed that the study will be carried out in next two years to achieve the objectives of the study and to determine Long Term Trend in net irrigation requirement and changes in total Irrigation Water Demand (IWD). Also, Dr Pandey presented a brief state of art on the studies conducted in other parts of the world related to the climate change and indicated that any change in meteorological variables adversely affects the crop productivity and thereby the regional economy. This study will yield the quantification of changes in irrigation water demand over past 50 years and projections for the next 50 years. He informed that the progress of the study is satisfactory.</p>
16.	<p>'Effect of Changing Global Tropospheric Temperature on Asia-Pacific monsoon Circulation and Rainfall Fields across India'.</p> <p style="text-align: center;"><b><u>Study Group:</u></b></p> <p>Ashwini Ranade</p> <p>DOS: Oct 2014 DOS: March 2017</p>	<p>Dr. Ashwini Ranade, PI of the project presented the study and explains about the motivation, objectives, dataset and the methodology of the project. She has also presented some of the preliminary results of the study. Dr. R.D. Deshpande asked about the TRMM rainfall data and recommended to use rain gauge data also. PI has informed that the data set is satellite and rain-gauge merged dataset and the data development is such that, the un-gauge areas are filled with satellite observations. He has advised to make more focus on the objectives of the study. Dr. Ritesh Arya well appreciated the approach of the research problem of studying extreme rain events (EREs) using changes in atmospheric general circulation and suggested to study Ladakh and Uttarakhand EREs as a special case. Overall working group has commented positively and express their views regarding the need of such type of study of Monsoon, EREs and Climate Change in NIH.</p>

## WATER RESOURCES SYSTEM DIVISION

Dr. Sharad K Jain, Sc. G and Head presented an overview of the division – scientific strength, the ongoing studies, sponsored & consultancy studies, technical publications and training courses organized. He also informed about the upcoming National Hydrology project (NHP) and National Mission for Sustainable Himalayan Ecosystem (NMSHE), and involvement of different scientists of the division. Following are the comments received from working group on the presentations of the various studies.

**PI: Dr. M. K. Goel, Scientist “G”**

***Study title: NIH\_Basin – A WINDOWS based model for water resources assessment in a river basin (Ongoing)***

Dr. M. K. Goel (MKG) presented the progress of the study. He informed that envisaged objectives of the study included modifications in the modeling methodology and development of WINDOWS interface named as **NIH\_Basin (NIH\_Basin Simulation)** of the model. MKG informed that gaining insight and experience from a recently awarded project in the Krishna river basin, a number of further modifications have been made in the model methodology (and the source code) for making it more practicable and realistic. Some of these modifications (which were not envisaged earlier) include:

- a) Outlet from hydropower can now join any d/s stream segment or go outside of the basin. The river segment needs to be specified in the hydraulic structure attribute file.
- b) GW potential factors are now specified for two conditions – Temporal (GWPFT) which depends on change in GW development with time and Position of current average GW table in the sub-basin (which is computed daily in each sub-basin).
- c) Population of cities with known population (say, Pune) within a district are added and compared with the specified population in the district (also within basin and with percent urban concept) and the rest of urban population is then uniformly distributed across various cities (with unknown population) in that district. A few checks are made and if required, city populations are revised or percent urban value is revised.
- d) If a city takes water from a river segment, a diversion structure needs to be specified at the end of river segment for diversion of water to the city. So river network file needs to be created after considering the city diversions.
- e) Variable name for Initial abstraction parameter Ia in the SCS CN equation (0.3 or 0.1) is specified. It needs to be provided for various soil types and AMC conditions.
- f) For the conditions when there is no crop on a grid (say, intermediate period between the Kharif and Rabi season), a landuse characteristic is defined in the crop attribute file for consideration during intermediate period.

Prof M. Perumal expressed that the methodology appears to be quite close to that of VIC model. MKG informed that a number of concepts in the model have been taken from different sources, say CPSP/BHIWA model of ICID, Mike Basin model and DSS of DHI etc. The aim is to integrate and use the huge database available in platforms such as India-WRIS for river basin planning and management. Dr. Sharad K. Jain added that model is planned to serve as a tool for supporting management and policy decisions at basin scale.

**PI: Dr. Sanjay K. Jain (SJ), Scientist “G”**

***1. Glacier change and glacier runoff variation in the upper Satluj river basin (Ongoing)***

Dr. Jain presented the objectives and the progress. Three sub-basins of Upper Satluj basin have been taken for this study. He informed that glacier change work has been completed and modelling work is under progress. Dr. Bartarya informed that GSI has studied glaciers in Satluj basin and this can also be reviewed. Dr. Jain informed that for climate scenarios, Dr. A P Dimri, JNU, New Delhi was contacted and results for the study area have been obtained from him. The climate change scenarios are being finalized. Dr. Jain also informed that due to glacier recession, a lake has been formed in one of the glaciers which is continuously expanding over the years. Mr. Ritesh Arya asked when the lake was noticed; Dr Jain said that since the year 2000 the lake is seen and increasing in size. Mr. R K Khanna informed that the Baspa project is coming up in the area. The information was noted down.

***2. Modelling of Narmada Basin using GWAVA Model (Ongoing)***

P K Mishra (PKM) presented the status as well as the progress of the study. He informed that Hydro-meteorological data and Hydrological data have been procured from IMD, Pune, and Central Water Commission, Bhopal respectively. The reservoir inflows data have been collected from Water Resources Department, Bhopal and computerized. Mr. Mishra informed about the Part II of the training on GWAVA Model Setup during June 2015 at Wallingford, UK. All the mandatory input files viz., Physical Parameter files, Water Demand Files and Climate Files in the required format have been completed. The virgin calibration run have been carried out, however some issues are being sorted out with regular interaction with CEH. He also emphasized that presently the model is being run based on the EXE file and the Tutorial exercise given by CEH. Many a times the understanding of the errors/messages that come up during the process of the model run is difficult. These issues has been shared with CEH.

**PI: D. S. Rathore (DSR), Scientist “F”**

In absence of DSR, the progress of the work in the study was presented by Dr Surjeet Singh.

***Decision Support System for Water Resources Planning in Upper Bhima basin, Maharashtra (Ongoing)***

A Decision Support System (Planning) was developed under Hydrology Project - II and case studies were done for pilot basins selected for States. In this study further development of applications and interfaces, porting of models to Mike Hydro is being carried out for Upper Bhima basin. Streamflow drought index (SDI) was computed for inflow to catchments and water quality modelling was carried out. Pollutant load was calculated source wise using population (interpolated values for rural, urban: municipal corporation, cumulative value for towns), livestock population and per unit load and total pollutant for agriculture source. Effluent pollutants were considered as diffuse source. Population fraction contributing to untreated sewage was based on pumped and generated sewage. Measured (BOD) and assumed (N, P, E Coli) concentrations and discharges were used in computing effluent pollutant load. Simulation was carried out for year 2006. Simulated and observed (average) values of water quality variables for Daund and Koregaon were matched in calibration. STP Effluent average BOD concentration is nearly 10 and 16 mg/l in Pune and PCMC respectively. The simulated water quality concentrations were compared at Koregaon and Daund stations. Simulated BOD values at Koregaon and Duand were 3 and 6 mg/l and measured values are 6 and 7.3 mg/l. For E Coli values were 200, 100 and 240, 194 MPN/ 100 ml respectively. NO<sub>3</sub>-N values were 0.6, 1.5 and 0.4, 0.5 respectively. Simulated NH<sub>3</sub>-N value for Koregaon was 0.2 mg/l. Simulated and observed values of NH<sub>3</sub>- N for Daund were 1 and 0.4 mg/l respectively. Simulated values of Total- P for Koregaon and Daund were 0.4 and 1.5 mg/l respectively. Observed Average Phosphate-P for Daund was 0.9 mg/l. Dr Ghosh enquired which scenario will be developed in

the decision support system. Dr. Singh Singh replied that presently modeling work is in progress and subsequently, scenario will be developed.

**PI: D. Chalisgaonkar (DC), Scientist “F”**

Mrs. Deepa Chalisgaonkar presented one ongoing study.

**1. Development of Ganga Information Portal**

DC presented the ongoing study on development of Ganga Information Portal, which is envisaged to provide a unique platform comprising multisource data and information on Ganga basin. The major objective is to develop a knowledge/ information e-portal with detailed information on Ganga basin. GIP is being developed using World Wide Web (WWW) technology in HTML and java script language. The main and drop down menus will allow the user to interact with the system very easily. The information relating to the Ganga will be collected from different sources and will be arranged between the time-spaces, and it will be possible to share, to search, to display, and to output (print) it. Dr. Deshpande suggested to include a ‘search window’ in the system. Dr. Sharad Jain also suggested to have a ‘search window’ in the main screen. Mrs. Deepa informed that as the data of Ganga basin is restricted, only the information will be provided on the portal with proper references.

**PI: Dr. Renoj J Thayyen (RJT), Scientist “D”**

RJT presented three studies.

**1. Glaciological studies of Phuque Glacier, Ladakh Range (Completed- Sponsored)**

This SERB sponsored project started in January 2010 and was completed in June 2015. RJT presented the completion report and important findings of the project. Generation of five years of summer and winter mass balance data of two glaciers in the cold-arid climate regime for the first time is a major achievements. New insights on huge precipitation gradient and summer mean temperature gradients of 10K/km is also developed in the study. Modeling of Slope environmental lapse rate of temperature (SELR) and summer mass balance is also achieved in the project. It is stated by RJT that the May –June temperature and precipitation is very critical for mass balance response of the studied glacier. R.D. Deshpande appreciated the effort made to execute this project and appreciated the new insights generated through this project.

**2. Cryospheric system studies and runoff modeling of Ganglass catchment, Leh, Ladakh Range (Ongoing)**

This project is aimed to evaluate the catchment scale hydrologic processes of the cold-arid regime. RJT informed about the damage occurred to the new discharge station at Gonpa near Leh by the flood on 5 August 2015. NIH station recorded 44 mm precipitation on 4th August 2015 at South Pullu monitoring station. RJT informed that the discharge measurement at 4700 m a.s.l. and meteorological data collection 3700 m a.s.l. is carried out during the reporting period and analysis is in progress. No specific suggestions were received for this project.

**3. Runoff modeling of Shyok River, Karakorum Range (Ongoing)**

This project is executed in coordination with border Roads Organisation (BRO) at Km 150 of Durbuk—DBO axis. The project has initiated in January 2015. RJT informed that a MoU is signed with BRO-HIMANK for the successful execution of this project. RJT informed that the Radar Water Level Recorder installed at Km 150 has given water level data of 5 minutes interval for the entire summer melt period. Stream cross section at KM 150 and stream velocity data is also generated with the help of BRO and discharge is calculated. RJT informed that this data set is the first discharge data of the Shyok river and this one data is used by the HIMANK-BRO to fine tune the proposed bridge design at this site. RJT informed that steps for procurement of AWS is in progress. Prof. Perumal enquired about the quality of the velocity data generated as it will impact scour depth estimate. RJT also agreed about the need to



improve the velocity measurement at the site and expected it happen once the collaboration and instrumentation matures at this site. Mr.Khanna from CWC highly appreciated the project and effort of NIH in helping the activities of border roads at the highly important and difficult border areas of the country. No specific suggestions received for this project.

**PI: Shri L N Thakural (LNT), Scientist “C”**

Shri Thakural presented one ongoing study.

***1. Study of Hydrological Changes in selected watersheds in view of Climate Change in India (Ongoing)***

LNT presented the background, objectives, methodology and the expected deliverables of the study and informed that four different watersheds located in different climatic regions namely Dhadhar river basin (Gujarat), Ramganga up to Kalagarh (Uttarakhand), Bina River basin (M.P) and Chaliyar river basin (Kerala) in India have been selected. While selecting the watersheds data availability and ease of accessibility to the watersheds were kept in mind. The status of the hydro-meteorological data viz. daily rainfall, daily temperature, discharge and ground water data collected for these river basins was also presented. The drainage network and watershed boundary maps generated for these watersheds using digital elevation model data of SRTM in GIS environment were also presented in the meeting. No specific suggestions were received for this project.

**PI: Shri M. K. Nema (MKN), Scientist “C”**

Mr. Nema presented one completed study and one ongoing study.

***1. Variability of the Hydro-climatic variables in Punjab Plains of lower Satluj (Completed)***

The final results of the study were presented by MKN. Dr. RD Deshpande suggested that some more inferences and their implications on agriculture should be drawn from the results and those may be included in the final report.

***2. Hydrological Processes and Characterization of Lesser Himalayan Catchments (Ongoing)***

MKN presented the progress of the study, which is experimental in nature and requires setting up instruments in the proposed watersheds, which is a time-taking and challenging job particularly in Himalayan conditions. He informed that the stream gauging structure at one stream is almost completed and is underway for another stream. On instruments part, work order for AWS has been placed and tendering process for AWLR is underway. The project team has also identified the location and piece of land for AWS installation.

**PI: Dr. P. K. Singh (PKS), Scientist “C”**

Dr. Singh presented one new study.

***1. Studies on Temporal Variation of Sediment Yield in Hilly Watershed of Upper Ganga Basin, Uttarakhand (New study)***

The study aims at estimation of temporal distribution of sediment yield and its total volume on storm basis. The study also explores the impacts of geo-morphological characteristics of basin and soil moisture accounting on temporal distribution of sediment yield. The storm data (runoff & sediment) gauged at Henva watershed (an ideal catchment to be established by WRS division) will be used for the study. Dr. N.C. Ghosh asked about the role soil moisture accounting (SMA) in sediment yield estimation. PKS briefed on the SMA during the presentation. The proposal was approved in its present form.

**PI: Shri P. K. Mishra (PKM), Scientist “B”**

**Study title: Assessing Climate Change Impact across KBK (Kalahandi-Bolangir-Koraput) region of Odisha (Ongoing)**

PKM presented the objective-wise progress made in the study since inception as well as during last six months (April ‘15-December ‘15). Shri Mishra presented the future rainfall and temperature downscaled from HadCM3 A2 and HadCM3 B2 GCM data utilizing SDSM model for the KBK region. He also presented the water availability and utilization for the Tel basin. He also informed about the completion of preparation of input files to run the Soil and Water Assessment Tool (SWAT) model.

**PI: Shri P. K. Agarwal (PKA), Scientist “B”**

**Study title: Hydrologic Modelling of a part of Satluj Basin using SWAT Model (Ongoing)**

The progress of the study was presented by PKA. He informed that the GIS layers required for SWAT model have been prepared. Meteorological data has also been downloaded and preparation of meteorological data base for the model is almost completed. No comments on the study have been received from the members of the working group.

#### WORK PROGRAMME FOR THE YEAR 2015-2016

S N	Title	Study Team	Duration	Funding (Rs. Lakhs)
<b>Completed Sponsored/ Internal Studies</b>				
1	Glaciological studies of Phuuche Glacier, Ladakh Range, India	Renoj J. Thayyen M K Goel, S P Rai	5 Years 1/10-06/15	DST (56)
2	Assessment of Environmental flows for Himalayan River	S. K. Jain, Pradeep Kumar, P. K. Agarwal, P. K. Mishra	1 Year 07/14-11/15	MOES (13.74)
3	Variability of the Hydro-climatic variables in Punjab Plains of Lower Satluj	M. K. Nema Sharad K. Jain	2 Years (11/13-10/15)	NIH (11.34)
4	Ganges Aquifer Management for Ecosystems Services (GAMES-IWMI)	Sharad K. Jain; N C Ghosh; Sudhir Kumar; M K Goel; Sanjay K. Jain; Surjeet Singh; Anupama Sharma;	1 year (06/2014-05/2015)	IWMI (16.9 lakh)
<b>Ongoing Internal Studies</b>				
1.	NIH_Basin – A WINDOWS based model for water resources assessment in a river basin	M. K. Goel, Sharad K. Jain, Deepa Chalisgaonkar Prabhash K. Mishra	3 Years (04/13-03/16)	NIH (16)
2.	Assessing climate change impact across KBK region of Odisha	P. K. Mishra, Sharad K. Jain, Sanjay K. Jain	3 Years (04/13-03/16)	NIH (28)
3.	Glacier change and glacier runoff variation in the upper Satluj river basin	Sanjay K. Jain, Sharad K. Jain, Renoj J. Thayyen	2.5 Years (10/13-03/16)	NIH (12)
4.	Catchment scale evaluation of cold-arid cryospheric system Hydrology, Ganglass catchment, Ladakh	Renoj J. Thayyen S. P. Rai, Sanjay K Jain Sudhir Kumar	3 years (04/14-03/17)	NIH (48)
5.	Hydrologic Modelling of a part of Satluj Basin using SWAT Model	P. K. Agarwal, Sharad K. Jain, T. Ahmad, M. K. Goel, Sanjay K. Jain, M.	2 -3/4 Years (06/14-3/17)	NIH (23)

		K. Nema		
6.	Decision Support System for Water Resources Planning in Upper Bhima basin, Maharashtra	D. S. Rathore, M. K. Goel, R.P. Pandey, Sanjay Kumar, Surjeet Singh	2 years (07/14-06/16)	NIH (34)
7.	Modeling of Narmada basin by using the GWAVA model	Sanjay K. Jain, Sharad K. Jain, T. Thomas (RC-Bhopal), P. K. Mishra, P. K. Agarwal, M. K. Nema	2.25 years Dec. 2014 – Mar 2017	NIH
8.	Runoff modeling of Shyok River, Karakorum Range	Renoj J.Thayyen Sanjay K.Jain	3 years 12/14 – 11/17	NIH (38)
9.	Hydrological process and characterization of Lesser Himalayan Catchments	M. K. Nema, Sharad K. Jain, Sanjay K. Jain, Renoj J.Thayyen, P. K. Mishra, P. K. Agarwal	5 Years 12/14-12/19	NIH+
10.	Development of Ganga Information Portal	D. Chalisgaonkar, Sharad K. Jain, D. S. Rathore, Sanjay K. Jain, Sudhir Kumar, P. K. Mishra, P. K. Agarwal, M. K. Nema	3 years (04/15-03/18)	MoWR (65.55)
11.	Study of hydrological changes in selected watersheds in view of climate change in India.	L. N. Thakural, D. S. Rathore, Surjeet Singh, T. Ahmad, Sanjay K. Jain, Sharad K. Jain	3 years (04/15-03/18)	NIH (44.30)
<b>Proposed New Internal Study</b>				
1.	Studies on Temporal Variation of Sediment Yield in Hilly Watershed of Upper Ganga Basin, Uttarakhand	P.K. Singh, Sharad K. Jain Sanjay K. Jain, M. K. Nema	2 Years 01/16-12/17	NIH (8.20)

## RESEARCH MANAGEMENT AND OUTREACH DIVISION (RMOD)

S.No.	Title of Project/Study, Study Team	Recommendations/Suggestions
1.	<p><b>Study- 1 (RMOD/2015-16/TS-1)</b> Water conservation and management in Ibrahimpur Masahi village of Hardwar district (Uttarakhand) <b>Team:</b> Omkar Singh, V.C. Goyal, C.K. Jain, J.V. Tyagi and Rajesh Singh DOS: April 2013, DOC: March 2016</p>	<p>The study was presented by Er. Omkar Singh (PI). Dr N. B. Narasimha Prasad (CWRDM) inquired about water demand estimation for different uses. The PI has responded to his queries. The WG members have appreciated the efforts to collect the household level base survey data for the preparation of village water conservation plan.</p>
2.	<p><b>Study- 2 (RMOD/2015-16/TS-2)</b> Customization of WEAP model for application in Ur river watershed in Tikamgarh district of Bundelkhand region. <b>(Under TIFAC Project)</b> <b>Team:</b> R V Kale (PI), T Thomas- RC Bhopal, Jyoti Patil, Rajesh Agarwal DOS: April 2014, DOC: January 2016</p>	<p>The study was presented by Dr. R.V. Kale (PI). The PI has requested permission to extend the study by four months which was accepted by the WG committee members.</p>
3.	<p><b>Study-3 (RMOD/2015-16/TS-3)</b> WEAP Model set up for four sub-basins under Pilot Basin Studies (PBS) Programme, jointly with the RCs/CFMSs  <b>NIH HQs:</b> V C Goyal (PBS Leader), Jyoti Patil and R V Kale <b>Co-investigators from NIH RCs/CFMSs:</b> Chandramohan T (RC-Belgaum), Y R S Rao (RC-Kakinada), T R Nayak (RC-Bhopal), B Chakravorty (CFMS-Patna) DOS: April 2015, DOC: March 2017</p>	<p>The study was presented by Dr. R.V. Kale. There were no any specific comments in this study.</p>

Dr. V C Goyal thanked the members for their valuable contributions during deliberations in the Working Group meeting.

The meeting ended with vote of thanks to the Chair.

**ANNEXURE-I****List of Working Group Members who attended the 42<sup>nd</sup> WG meeting**

1.	Er. R.D. Singh, Director, NIH	Chairman
2.	Dr. S.K. Bartarya, WIHG, Dehradun	Member
3.	Dr. Dinesh Chand, Min.of Drinking Water & Sanitation, New Delhi	Member
4.	Sh. Anurag Khanna, CGWB, Dehradun	Member
5.	Dr. R. D. Deshpande, Sc.SF, PRL, Ahmedabad	Member
6.	Dr. N.B. Narasimha Prasad, Ex. Director, CWRDM. Kozhikode	Member
7.	Dr. D. V. Reddy, CSIR-NGRI, Hyderabad	Member
8.	Dr. G. P. Juyal, CSWCRTI, Dehradun	Member
9.	Dr. S. K. Mittal, CSIR-CSIO, Chandigarh	Member
10.	Dr. V.V. Rao, NRSC, Hyderabad	Member
11.	Er. Niladri Naha, SWID, Kolkata	Member
12.	Dr. Ritesh Arya, Panchkula, Haryana	Member
13.	Er. R.K. Khanna (Retd.) CWC, New Delhi	Member
14.	Dr. M.Perumal, IIT, Roorkee	Member
15.	Er. Rishi Srivastava, CWC, New Delhi	Member
16.	Dr. Sharad K. Jain, Sc. G & Head WRS Division, NIH	Member
17.	Dr. N.C. Ghosh, Sc. G & Head GWH Division, NIH	Member
18.	Dr. Rakesh Kumar, Sc. G & Head SWH Division, NIH	Member
19.	Dr. Sudhir Kumar, Sc. G & Head HI Division, NIH	Member
20.	Dr. V C Goyal, Sc. G & Head, RMO Division, NIH	Member-Secretary

**Scientists from National Institute of Hydrology, Roorkee**

	<b>EH Division</b>		<b>SWH Division</b>
1	Dr. R.D. Mehta, Sc.D	17	Dr. J.V. Tyagi, Sc.G
2	Dr. M.K. Sharma, Sc.D	18	Dr. S.K. Singh, Sc.F
3	Dr. Rajesh Singh, Sc.C	19	Dr. R.P. Pandey, Sc.F
	<b>GWH Division</b>	20	Dr.A R Senthil Kumar, Sc.D
4	Er. C.P. Kumar, Sc.G	21	Dr. Sanjay Kumar, Sc.D
5	Dr. Anupama Sharma, Sc.D	22	Dr (Mrs) Archana Sarkar, Sc.D
6	Dr. Surjeet Singh, Sc.D	23	Dr. Manohar Arora, Sc.D
7	Er. Sumant Kumar, Sc.C	24	Sh. Digamber Singh, Sc.C
8	Ms. Suman Gurjar, Sc.C	25	Sh. J.P. Patra, Sc.C
9	Dr. Gopal Krishan, Sc.C	26	Dr. Ashwini A. Ranade, Sc.C
	<b>HI Division</b>		
10	Dr.Suhas Khobragade, Sc.E		<b>WRS Division</b>
11	Dr. S.P. Rai, Sc.E	27	Dr. Sanjay Jain, Sc.G
12	Dr. M.S. Rao, Sc.D	28	Dr. M.K. Goel, Sc.G
13	Sh. S.K. Verma, Sc.D	29	Mrs. Deepa Chalisgaonkar, Sc.F
14	Sh. P.K. Garg, Sc.B	30	Dr. Renoj J. Thayyen, Sc.D
	<b>RMO Division</b>	31	Dr. L.N. Thakural, Sc.C
15	Er. Omkar Singh, Sc.F	32	Sh. Manish Nema, Sc.C
16	Dr. Ravindra Vitthal Kale, Sc.C	33	Dr. P.K. Singh, Sc.C
		34	Sh. P.K. Mishra, Sc.B
		35	Sh. Tanveer Ahmad, Sc.B
		36	Sh. P.K. Agrawal, Sc.B